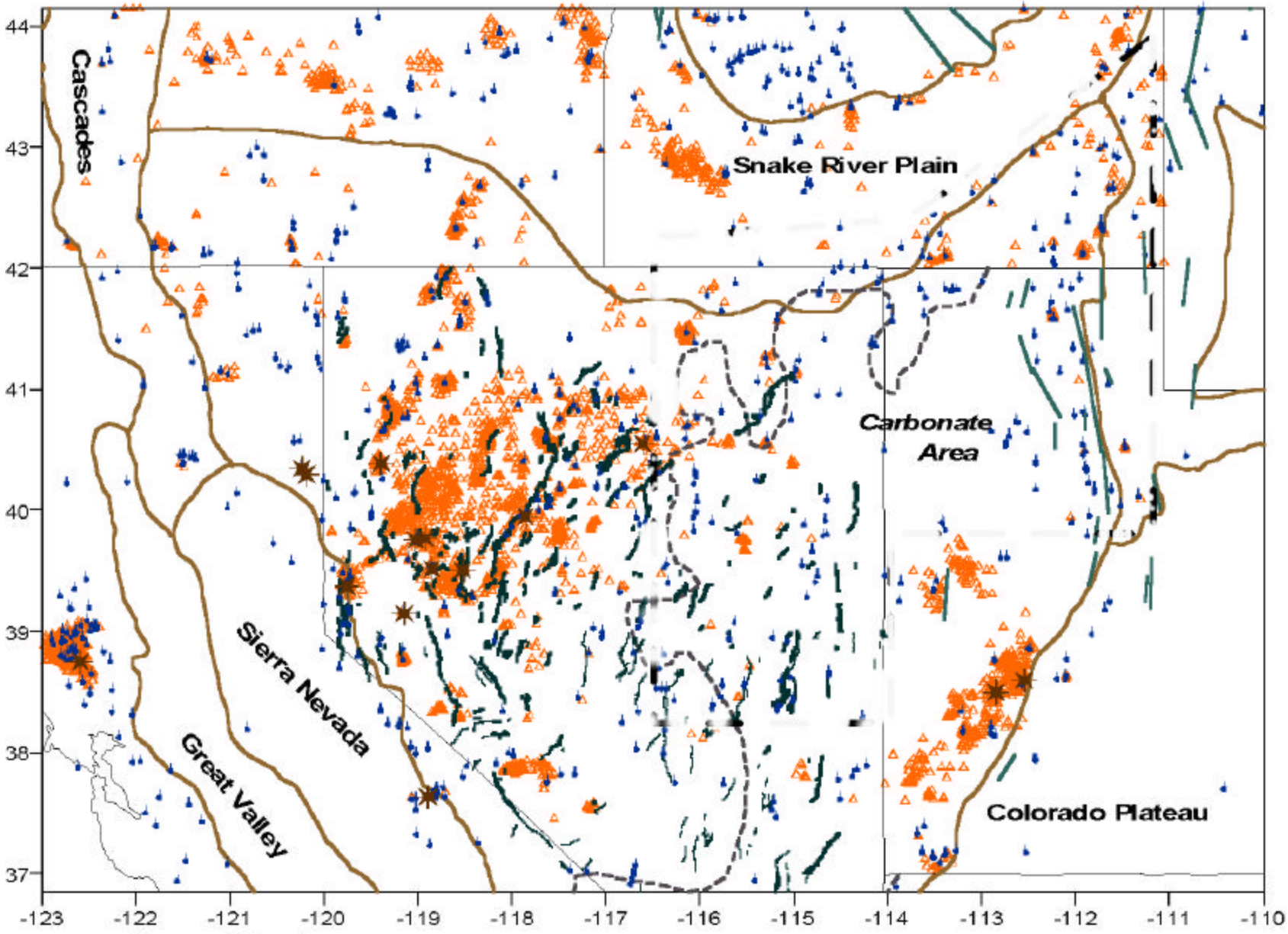
Basin and Range Structure in Dixie Valley Nevada

Back to Agenda

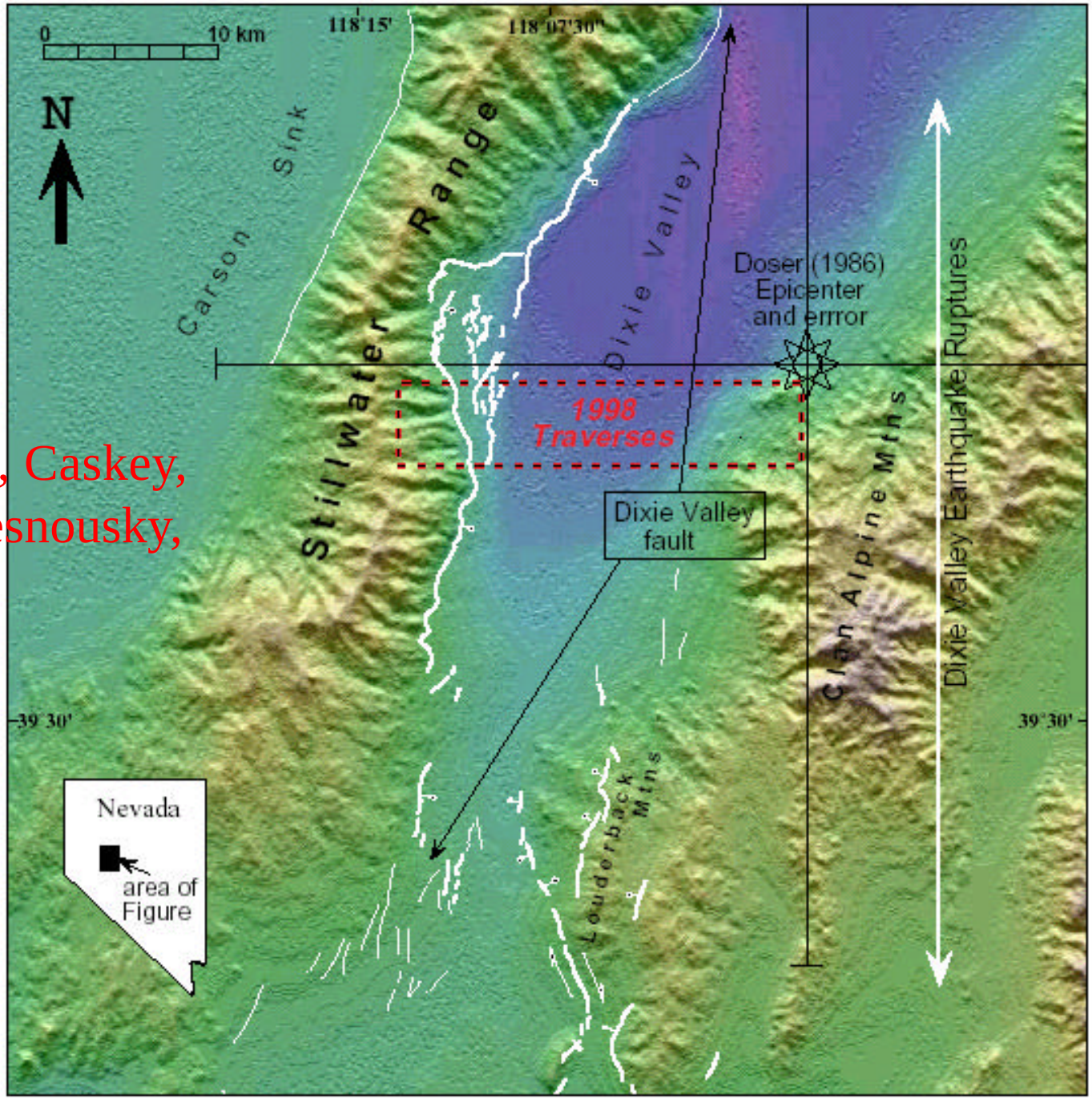
David Blackwell
Ken Wisian
Jason McKenna
Mark Leidig

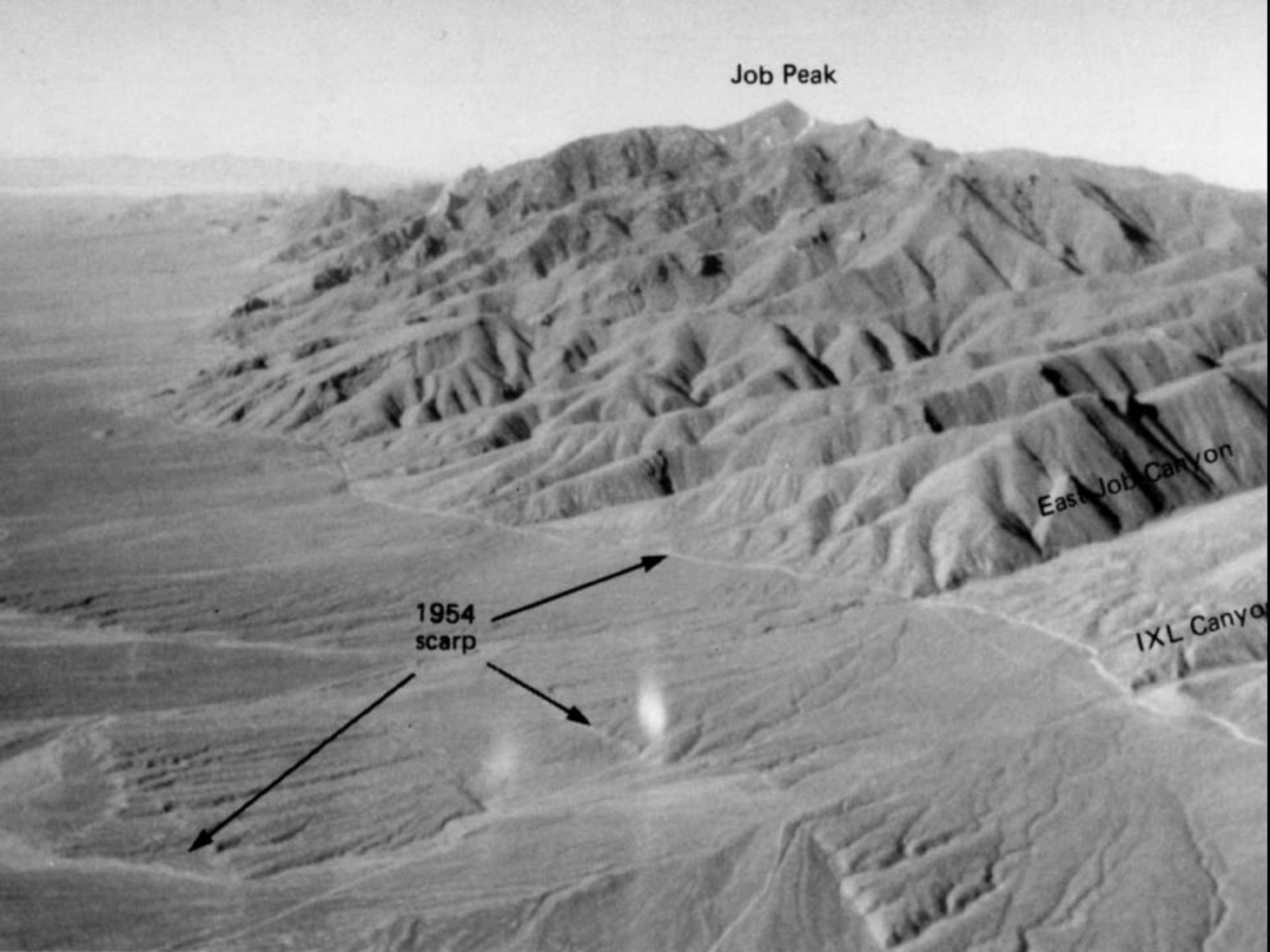
Geothermal Laboratory
Southern Methodist U.
Dallas, Texas

Support by Caithness, Oxbow, USDOE


Cascades
Snake River Plain
Carbonate Area
Sierra Nevada
Great Valley
Colorado Plateau
44
43
42
41
40
39
38
37
-123
-122
-121
-120
-119
-118
-117
-116
-115
-114
-113
-112
-111
-110
Power Plants -
Well Locations -
Thermal Springs -
Pleistocene and younger Faults -
Carbonate Aquifers Boundary -
Physiographic Boundaries -

Louie, Caskey, & Wesnousky, 1999




Job Peak
East Job Canyon
1954
scarp
IXL Canyo

THE DIXIE VALLEY, NEVADA NORMAL FAULT ZONE, STEEP, DEEP, AND HOT

The thermal structures are the Basin and Range normal faults (open extensional features, refractured regularly, long lasting)

The thermal structures in Dixie Valley penetrate deeply into the crust (close to the brittle-ductile transition)

Temperatures are over 200 °C at 3 km over a strike length of at least 20 km

Temperatures are over 245 °C at 3 km over a strike length of at least 10 km

Temperatures reach 285°C at 3 km in the DVPP area

Fluid inclusion studies show that these conditions have held for time scales on the order of My

Thermal data and dating show a present system duration of >100,000 yrs

No evidence of magmatic intervention (He)

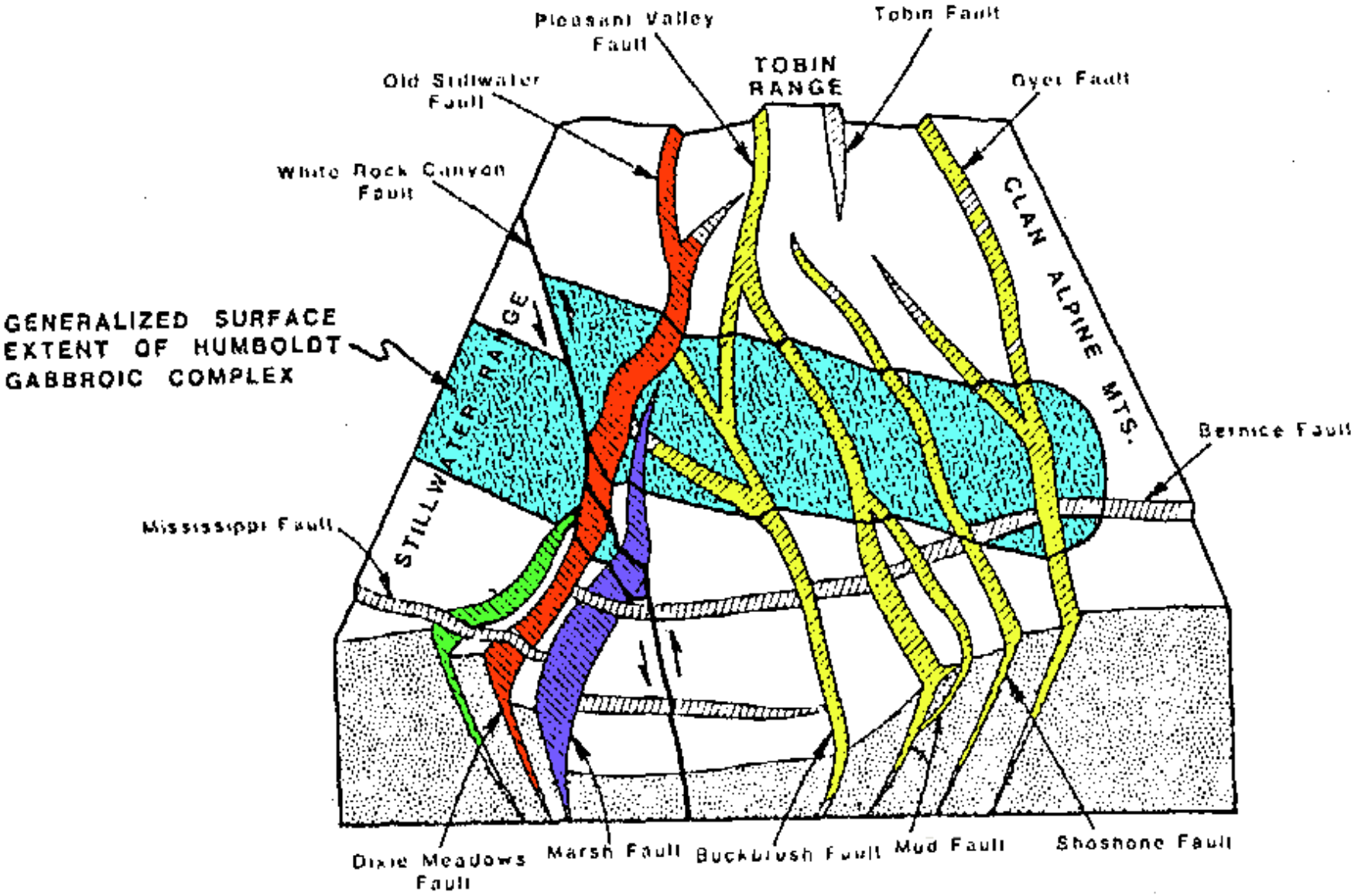
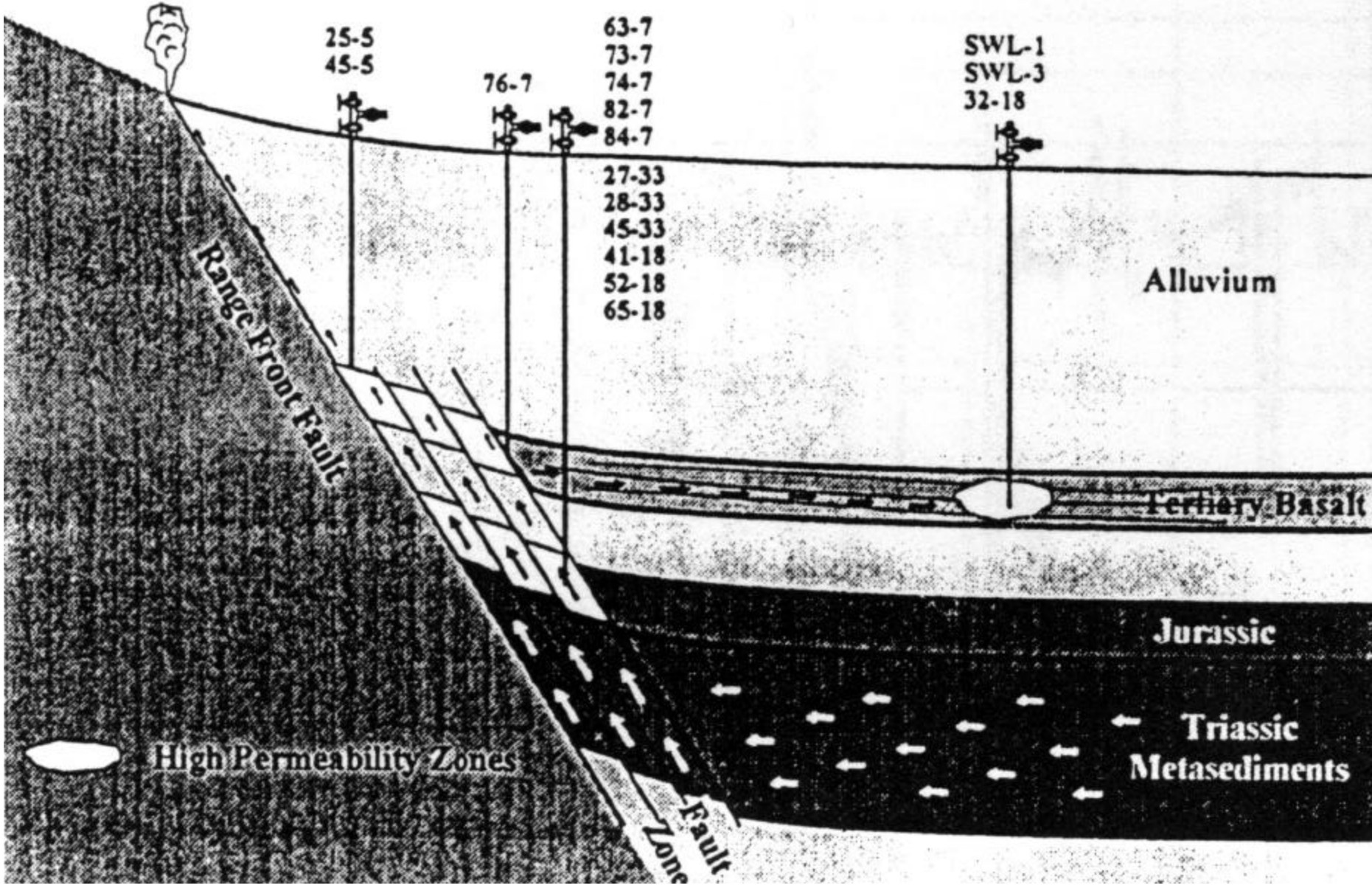


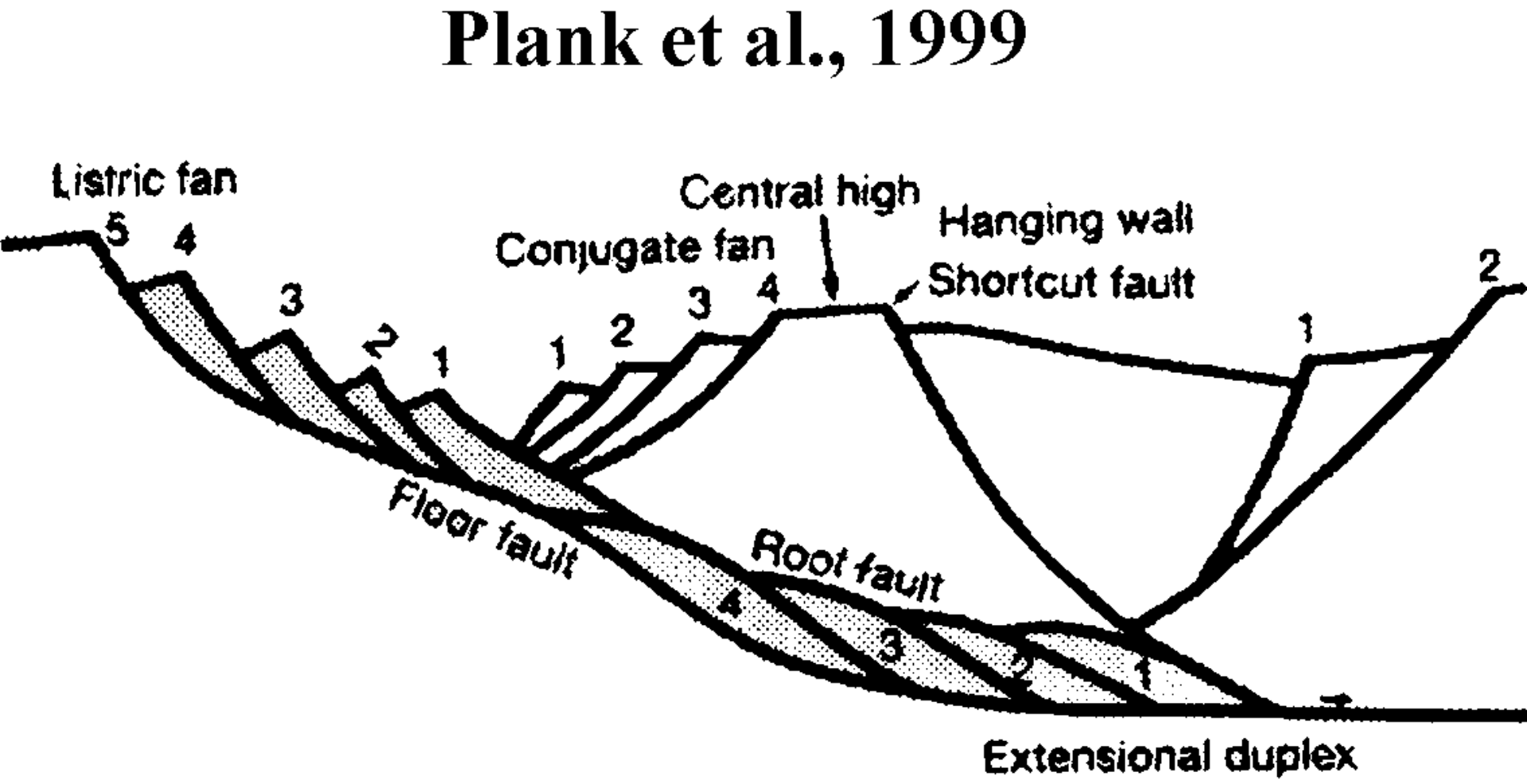
Figure 8. Three-dimensional model of the northern portion of Dixie Valley. Structural relationships among the various tectonic elements are depicted, with alluvium removed and the bedrock surface restored (from Whitney, 1980).

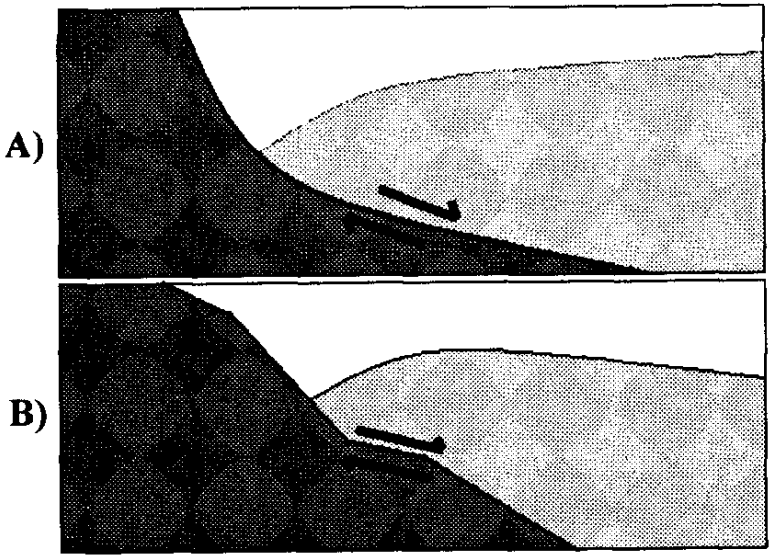
DIXIE VALLEY CONCEPTUAL GEOLOGICAL MODEL

Classic B&R shear fault dip model, Beniot, 1992)

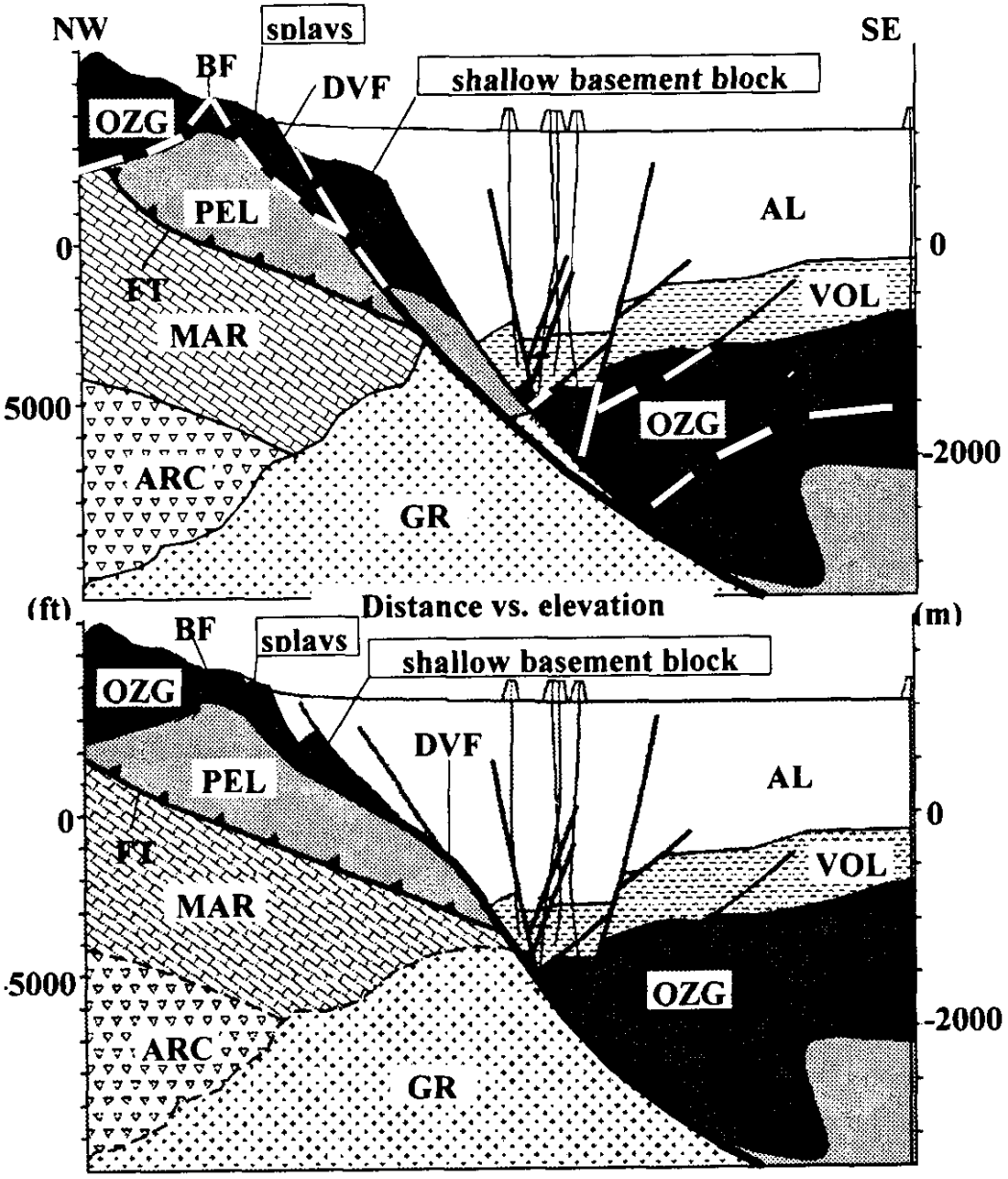


Listric Model, proposed for 1954 DV earthquake and DVPF



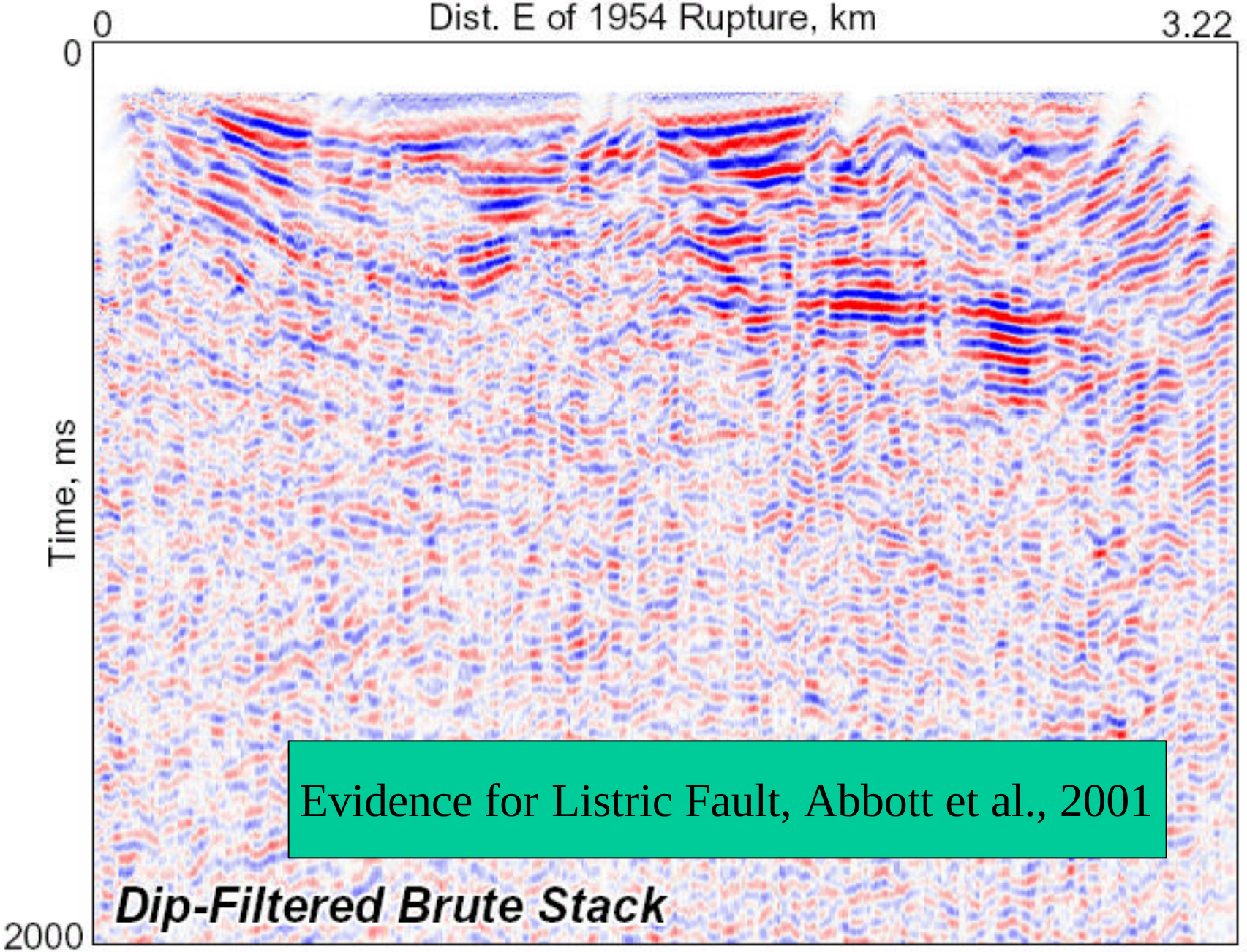


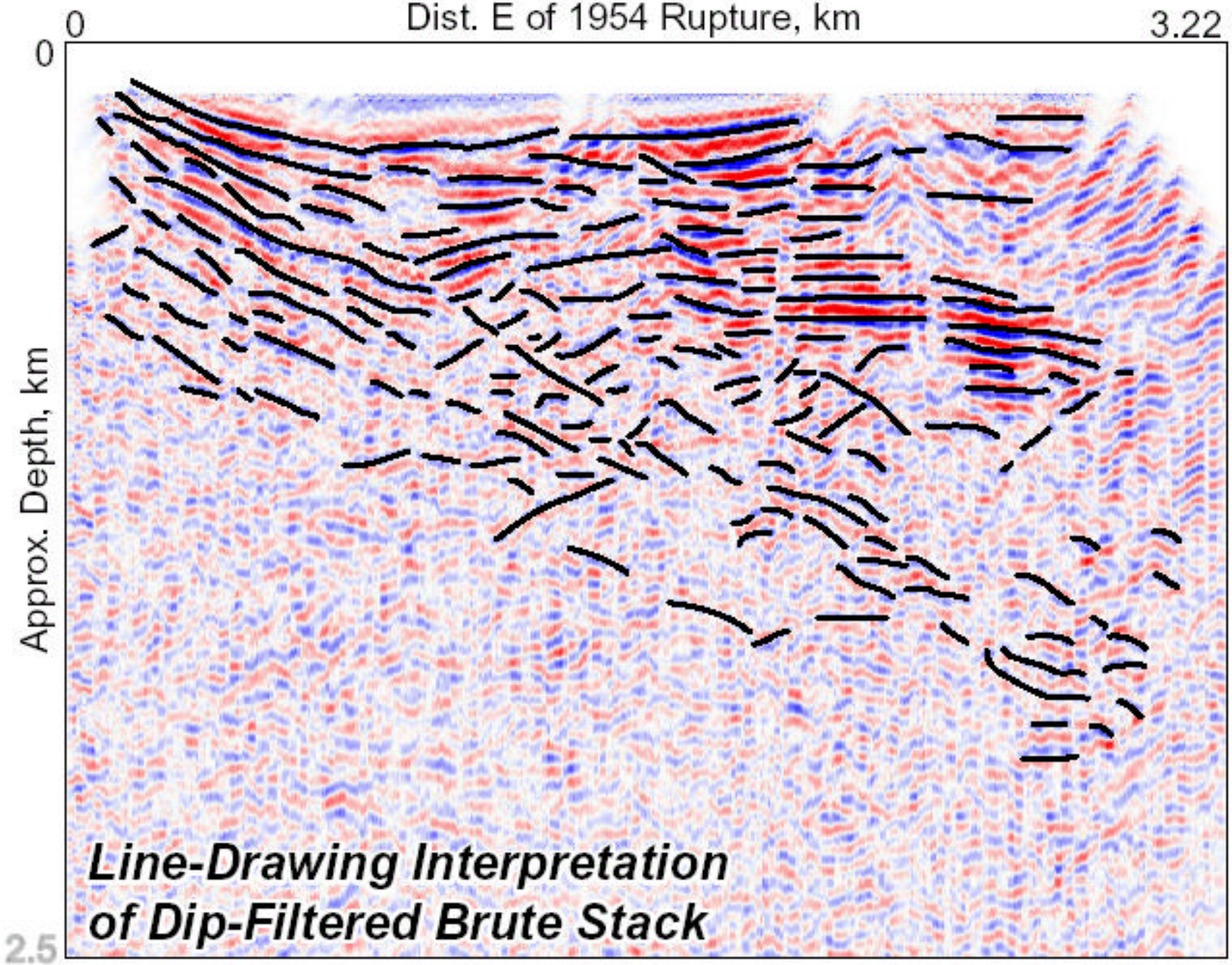
A)Listric fault surface geometry. B)Ramp-flat fault surface geometry.

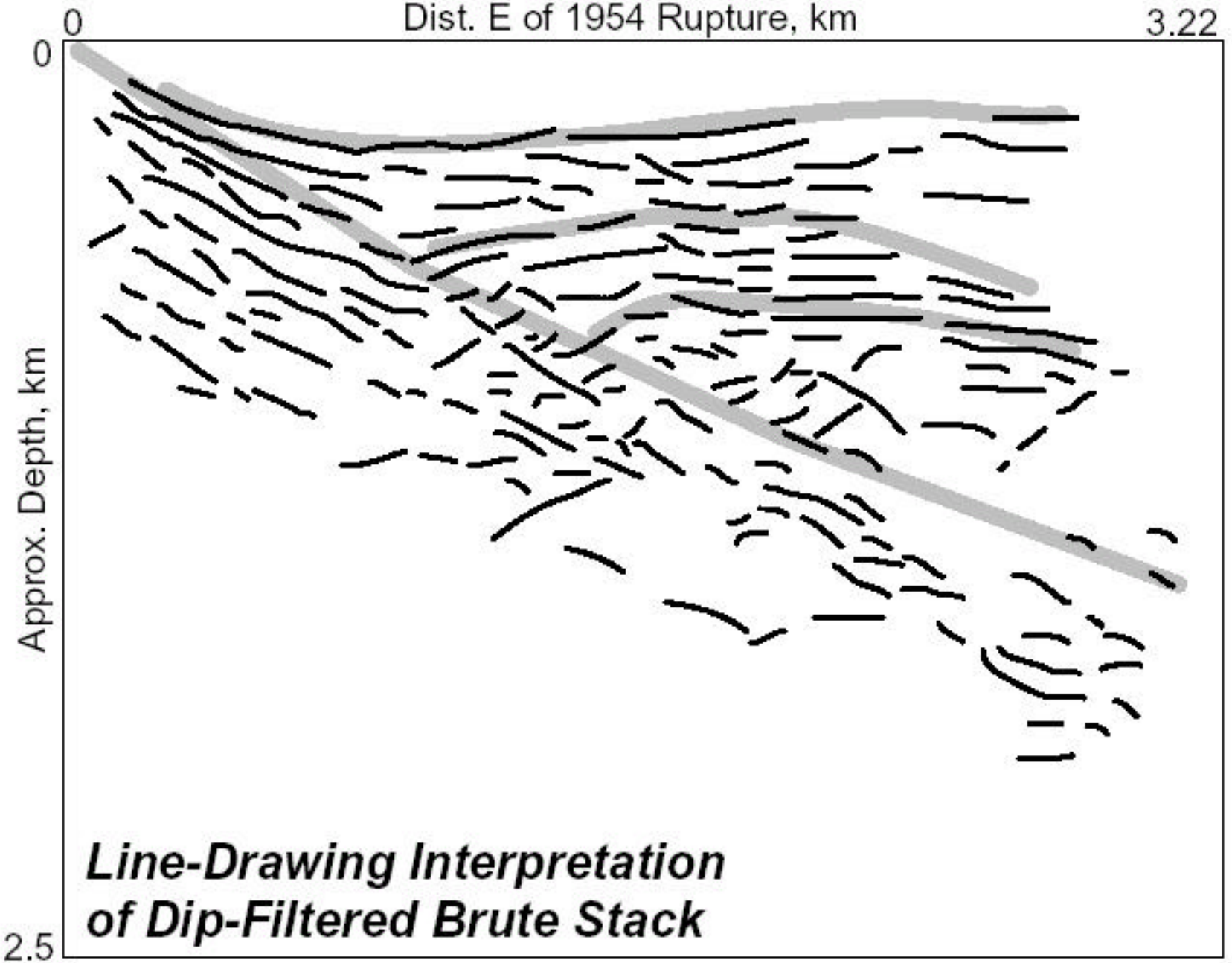


Cross Section through Stillwater Range/Dixie Valley contact. QZG, quartzite & gabbro; PEL, pelitic rocks, MAR, Marble; GR, granite, ARC, magmatic arc rocks, VOL, middle Cenozoic volcanics; AL, alluvium. BF is Boyer fault and FT is Fencemaker Thrust.

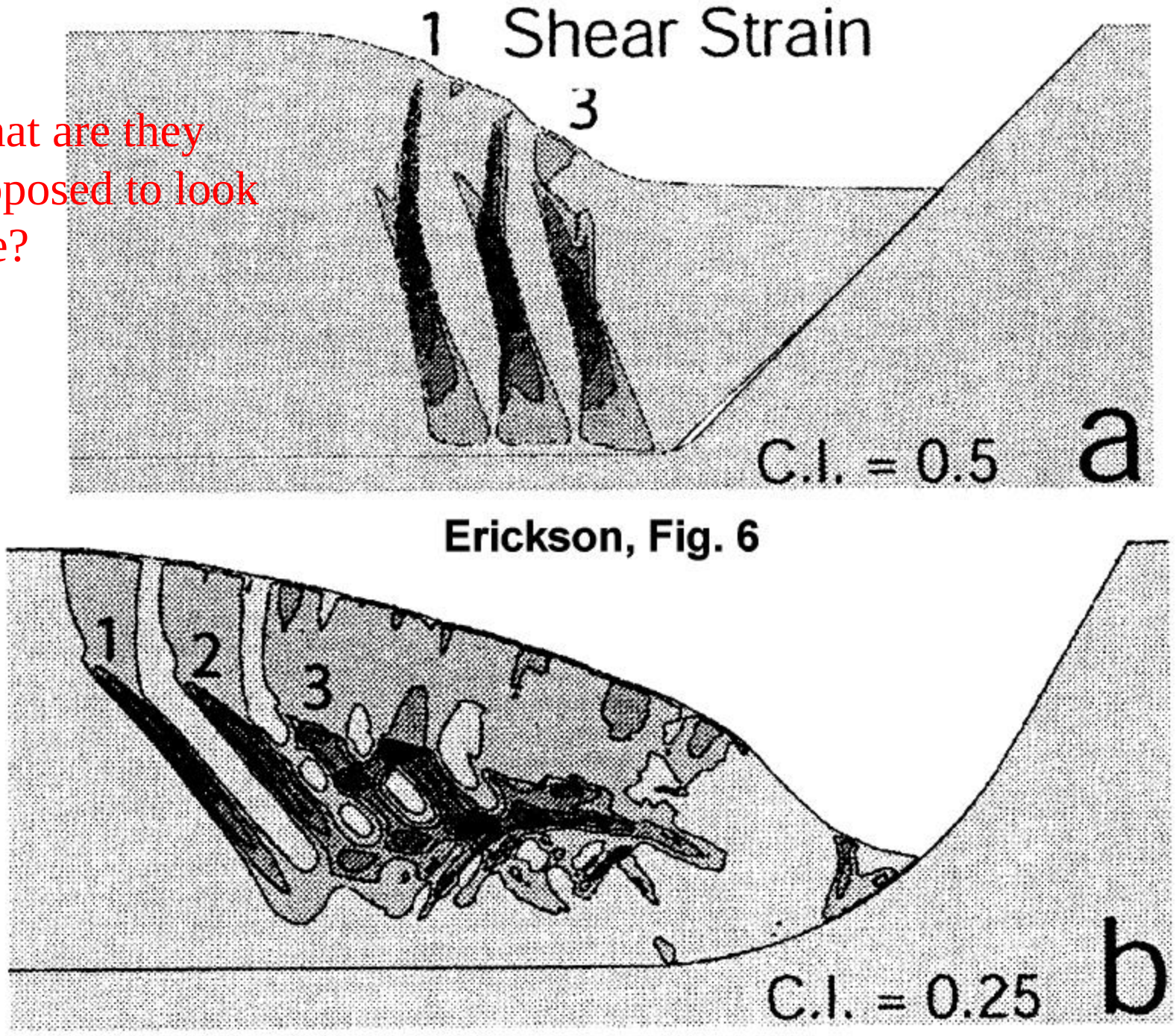
Details of Listric Model


0
Dist. E of 1954 Rupture, km
3.22
0
Time, ms
2000
Evidence for Listric Fault, Abbott et al., 2001
Dip-Filtered Brute Stack


0
Dist. E of 1954 Rupture, km
3.22
0
Approx. Depth, km
2.5
Line-Drawing Interpretation
of Dip-Filtered Brute Stack

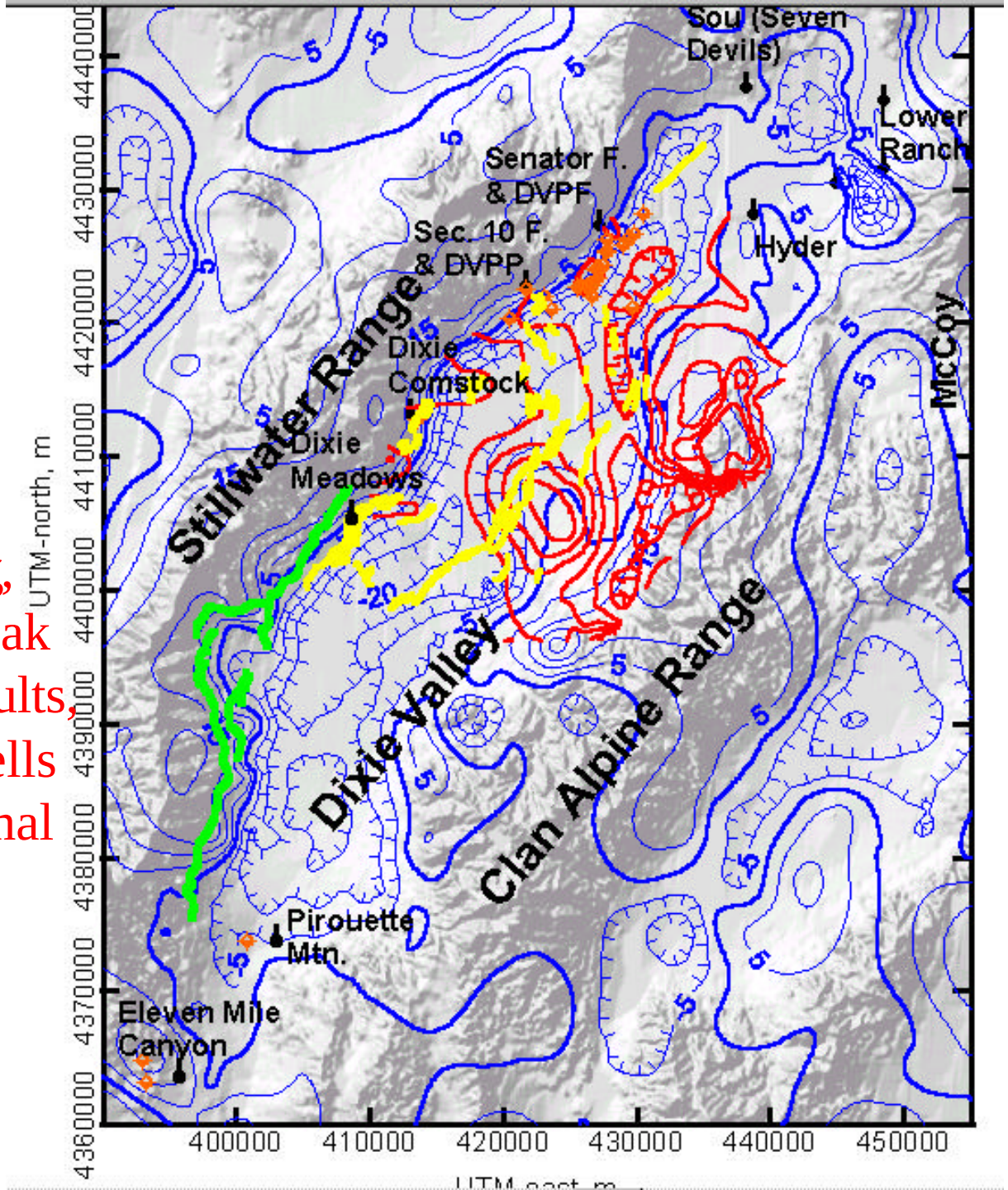

0
Dist. E of 1954 Rupture, km
3.22
0
Approx. Depth, km
2.5
Line-Drawing Interpretation
of Dip-Filtered Brute Stack

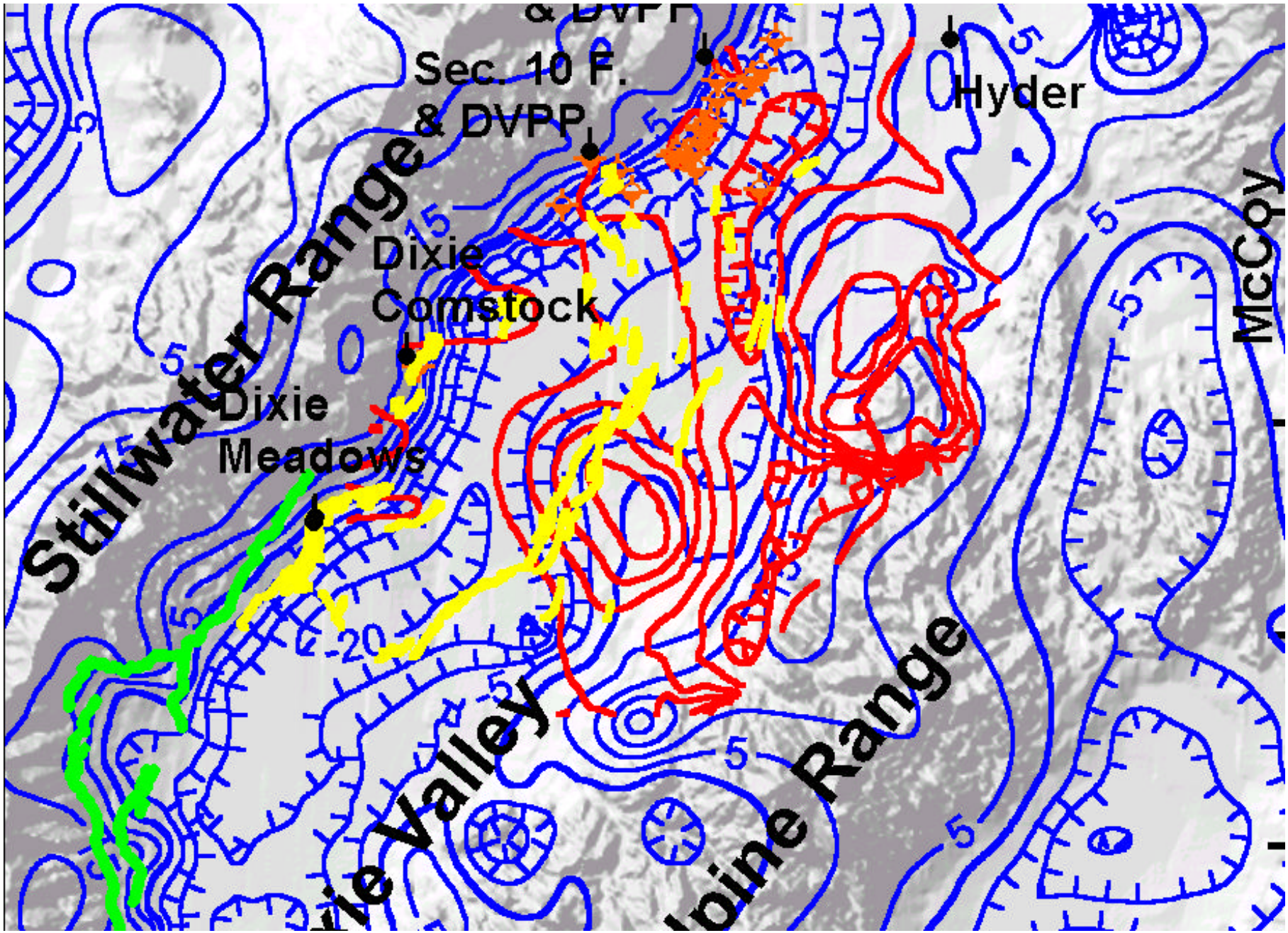
What are they supposed to look like?

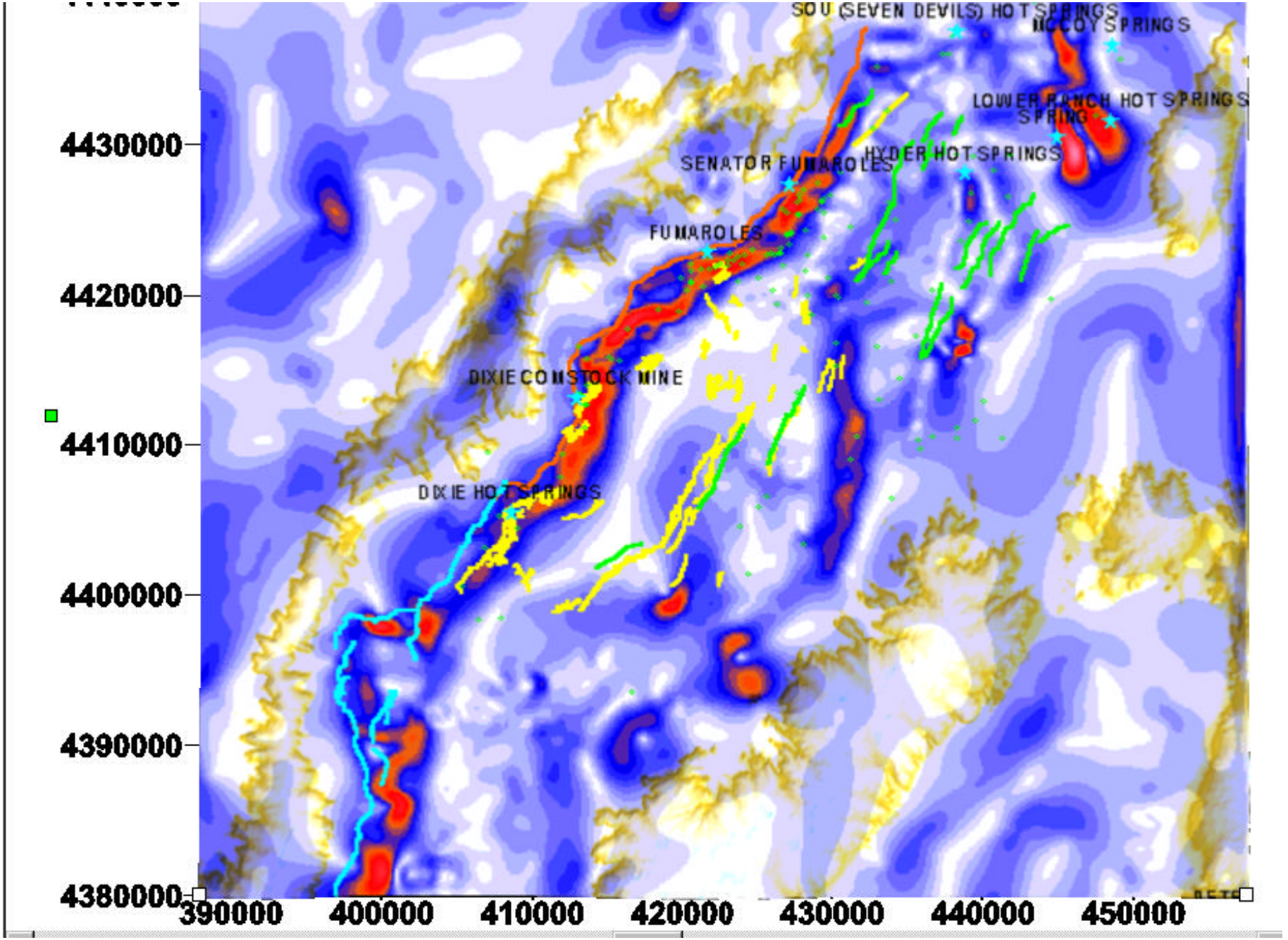


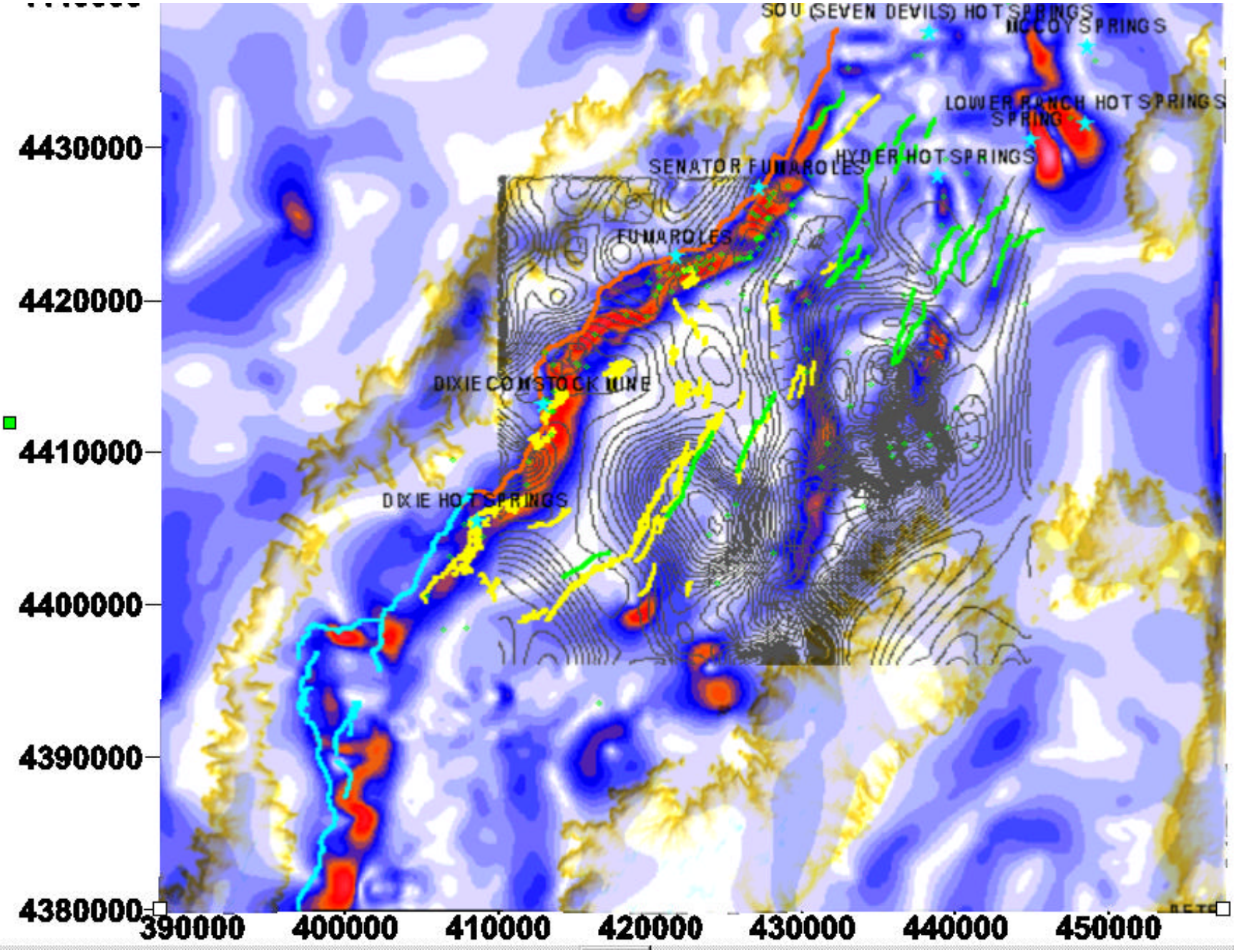
Erickson, Fig. 6

Residual Bouguer Gravity, Aeromag, 1954 Break young faults, Deep Wells Geothermal Systems




Sec. 10 F.
& DVPP
Hyder
Dixie
Comstock
Dixie
Meadows
Stillwater Range
McCoy


SOU (SEVEN DEVILS) HOT SPRINGS
MCCOY SPRINGS
LOWER RANCH HOT SPRINGS
SPRING
HYDER HOT SPRINGS
SENATOR FUMAROLES
FUMAROLES
DIXIE COMSTOCK MINE
DIXIE HOT SPRINGS
4430000
4420000
4410000
4400000
4390000
4380000
390000
400000
410000
420000
430000
440000
450000


SOU (SEVEN DEVILS) HOT SPRINGS
MCCOY SPRINGS
LOWER RANCH HOT SPRINGS
SPRING
HYDER HOT SPRINGS
SENATOR FUMAROLES
FUMAROLES
DIXIE COMSTOCK MINE
DIXIE HOT SPRINGS
4430000
4420000
4410000
4400000
4390000
4380000
390000
400000
410000
420000
430000
440000
450000

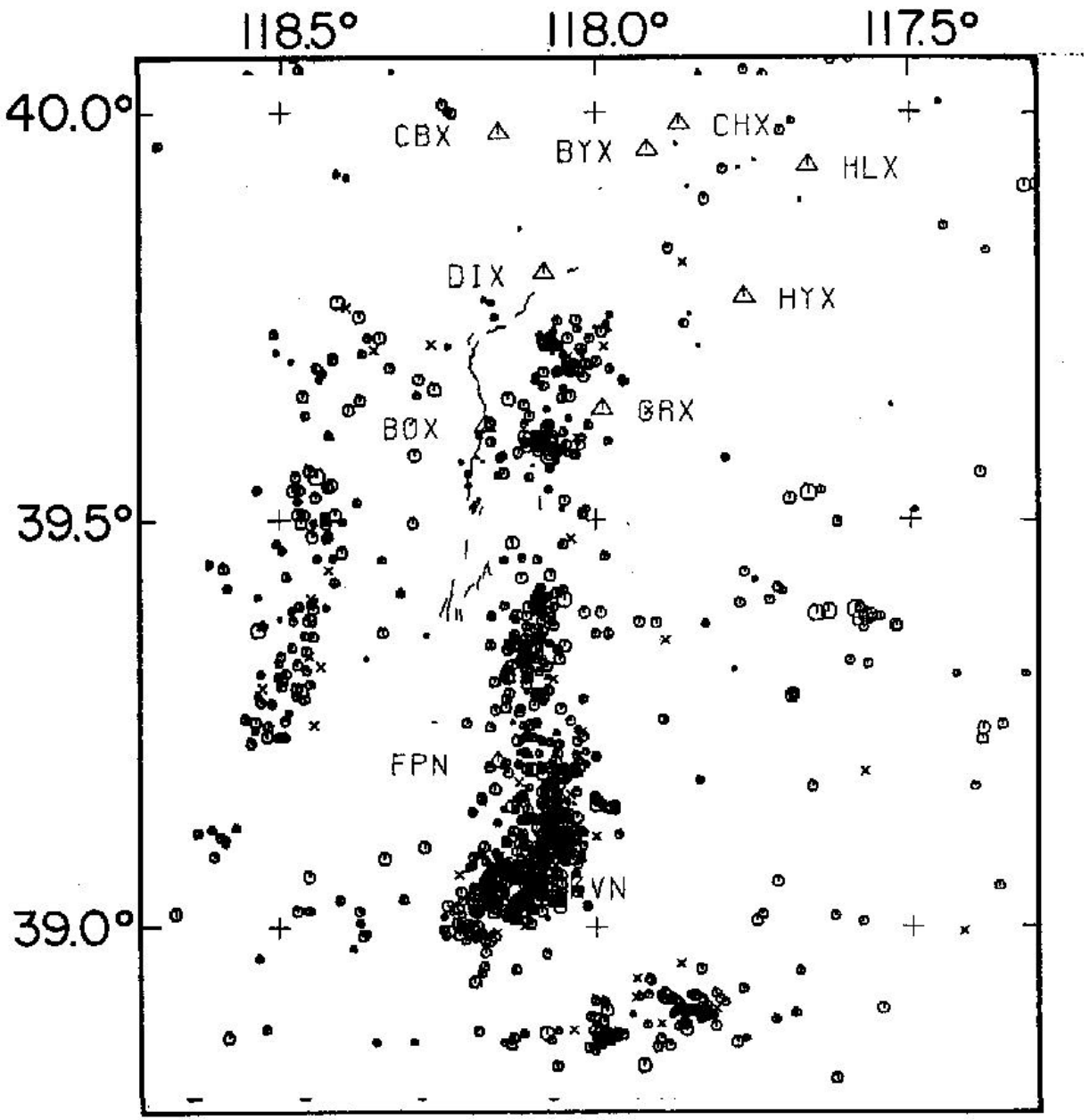


Figure 14. Earthquakes in the Dixie Valley-Fairview Peak area, 1970-1981.

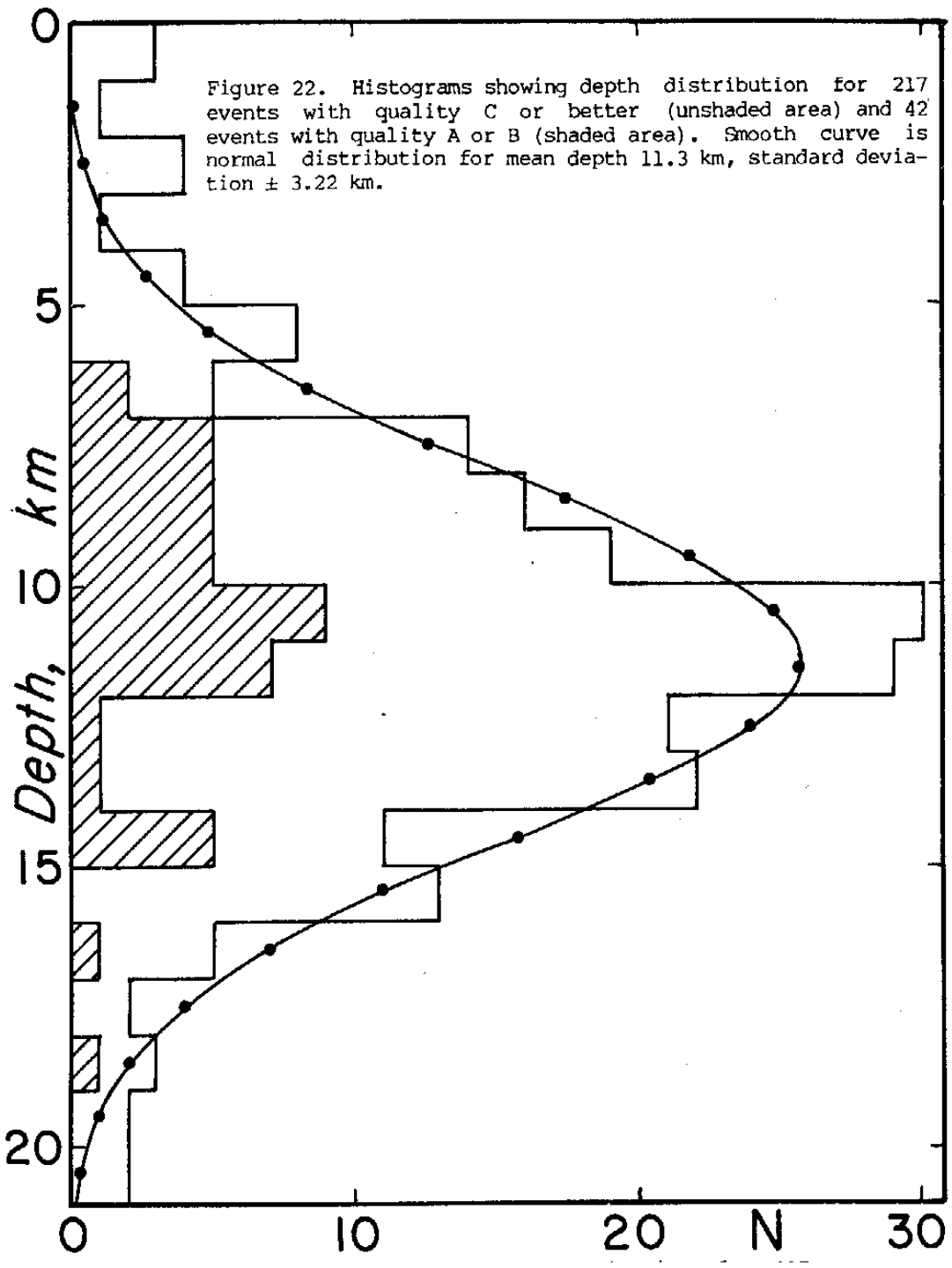
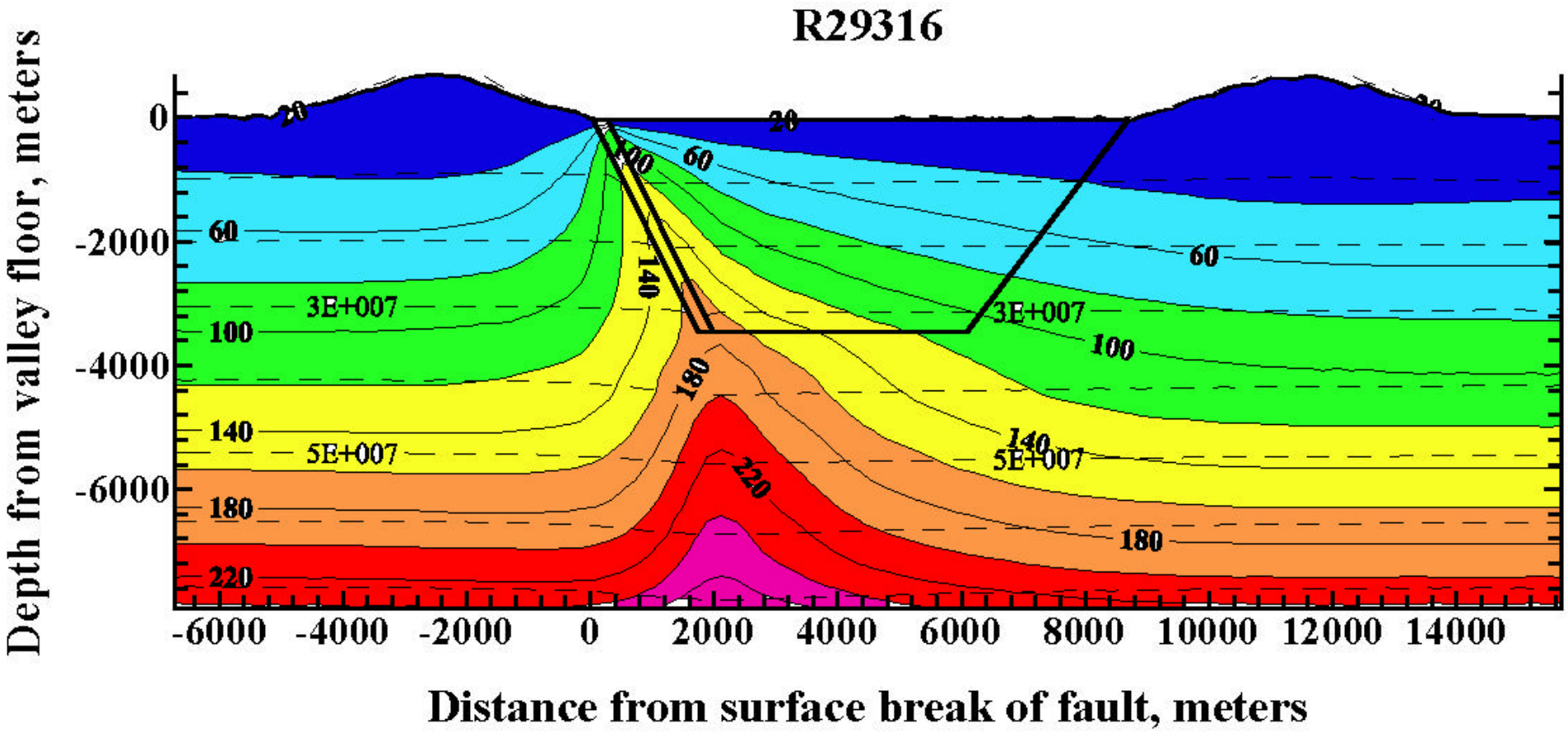


Figure 22. Histograms showing depth distribution for 217 events with quality C or better (unshaded area) and 42 events with quality A or B (shaded area). Smooth curve is normal distribution for mean depth 11.3 km, standard deviation ± 3.22 km.

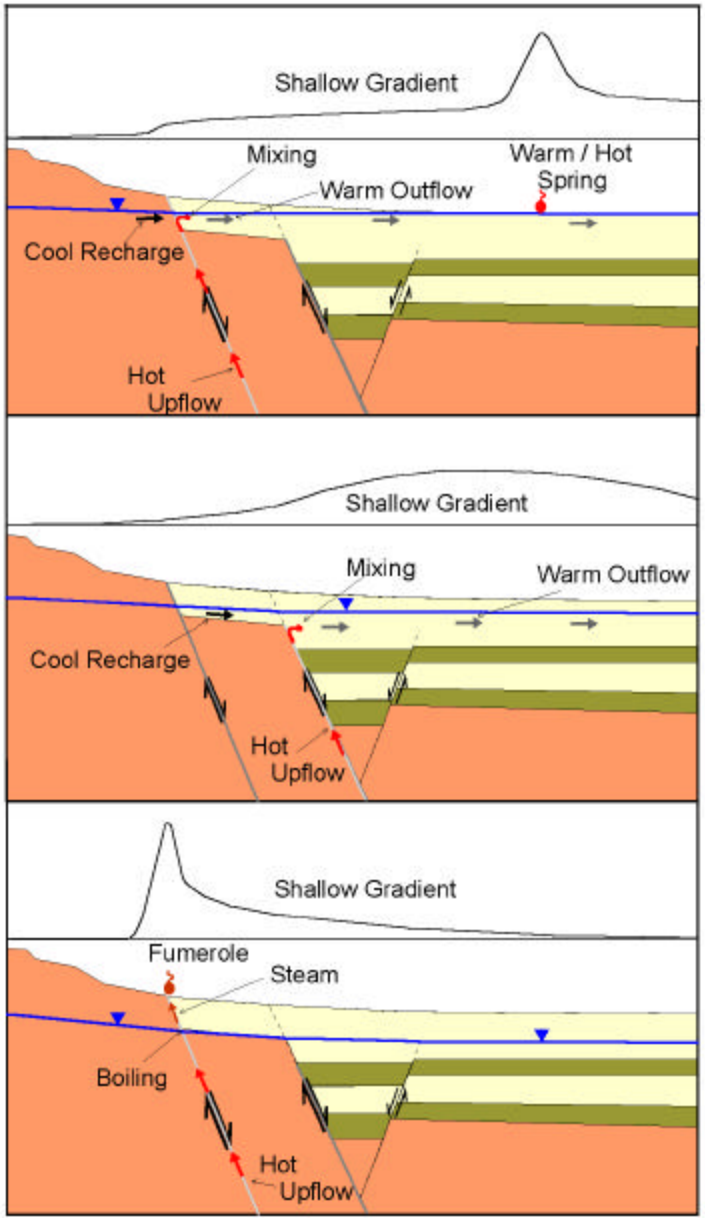


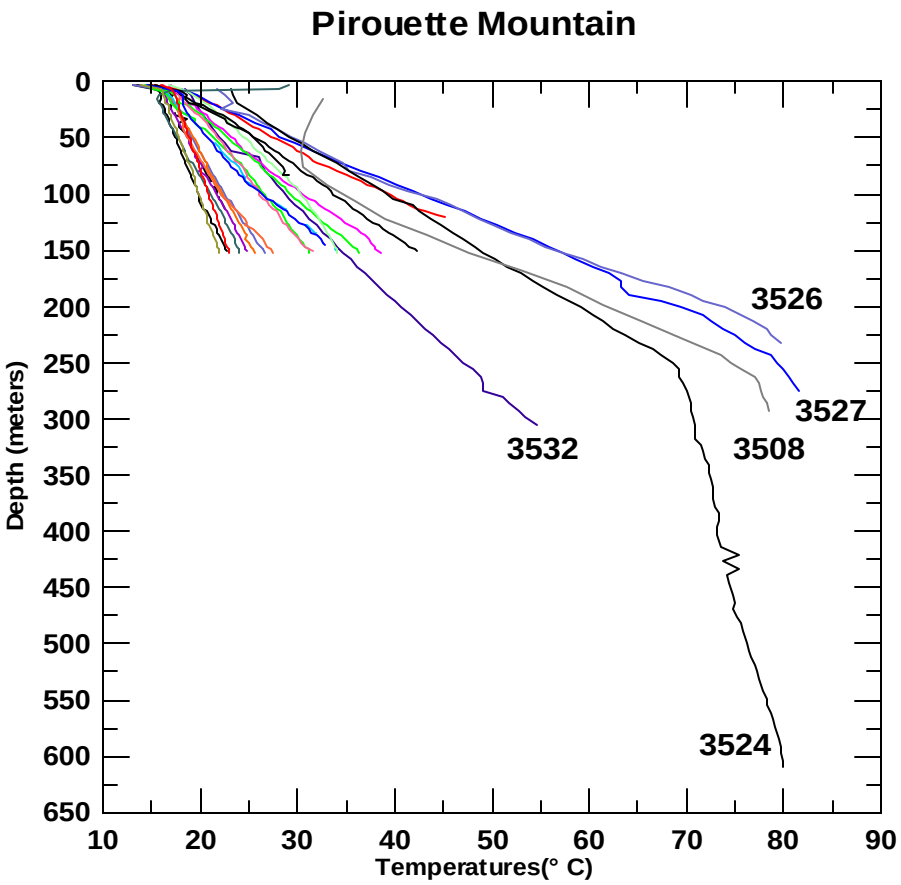
Natural State Flow Model, Deep Flow is Required to Reach 285C

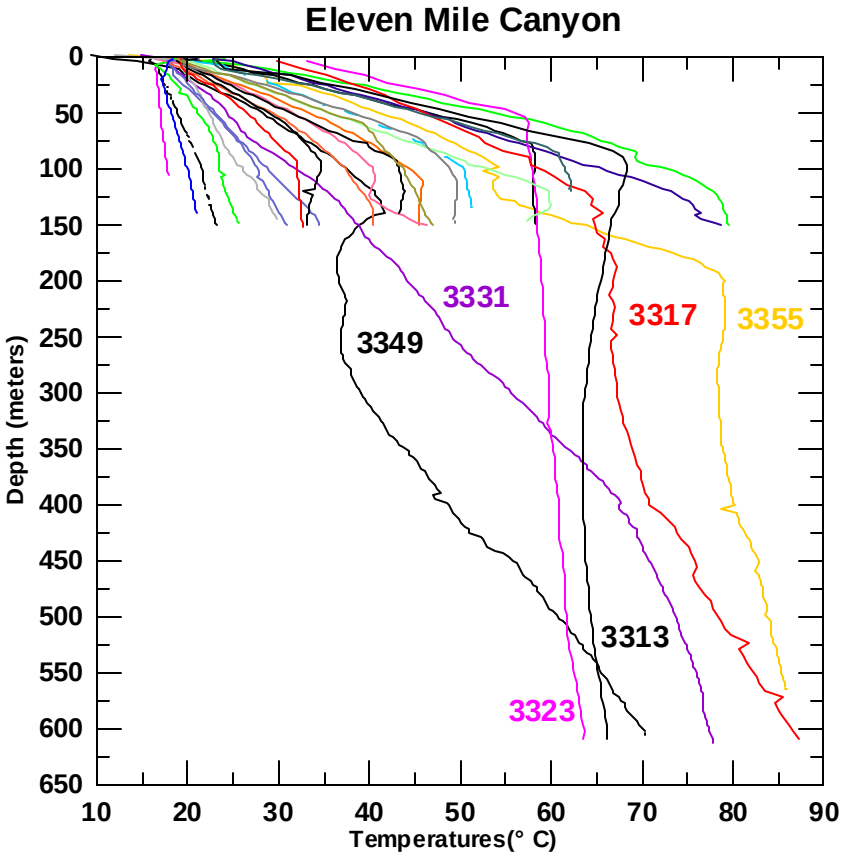
(pressure contours dashed)

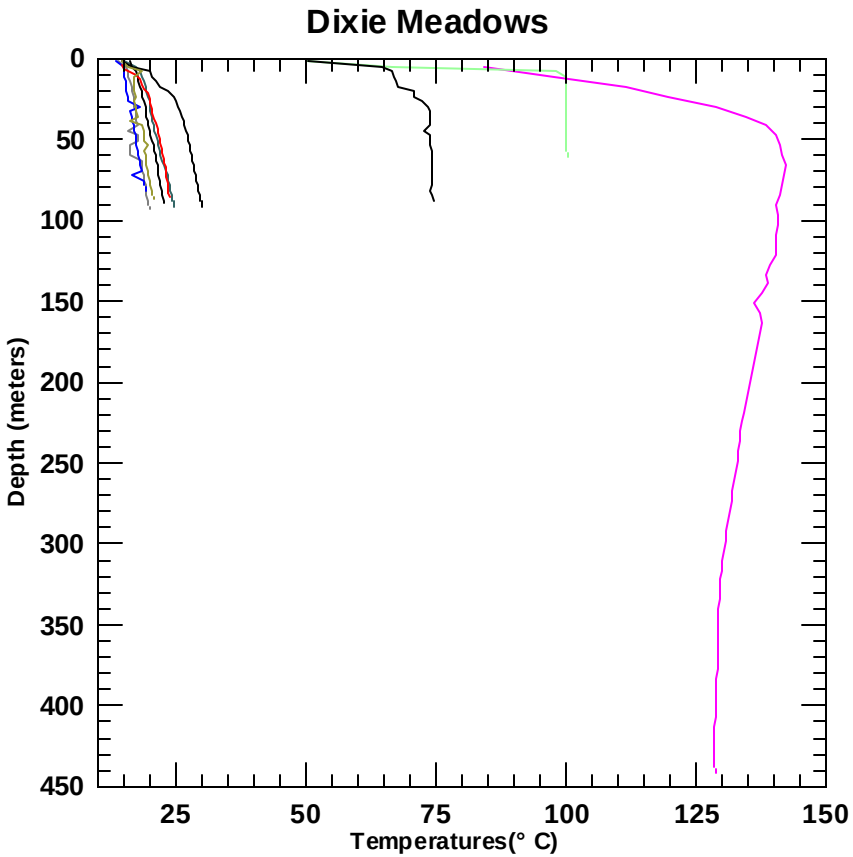
Characteristics of Shallow Thermal Anomalies: Basin and Range Systems

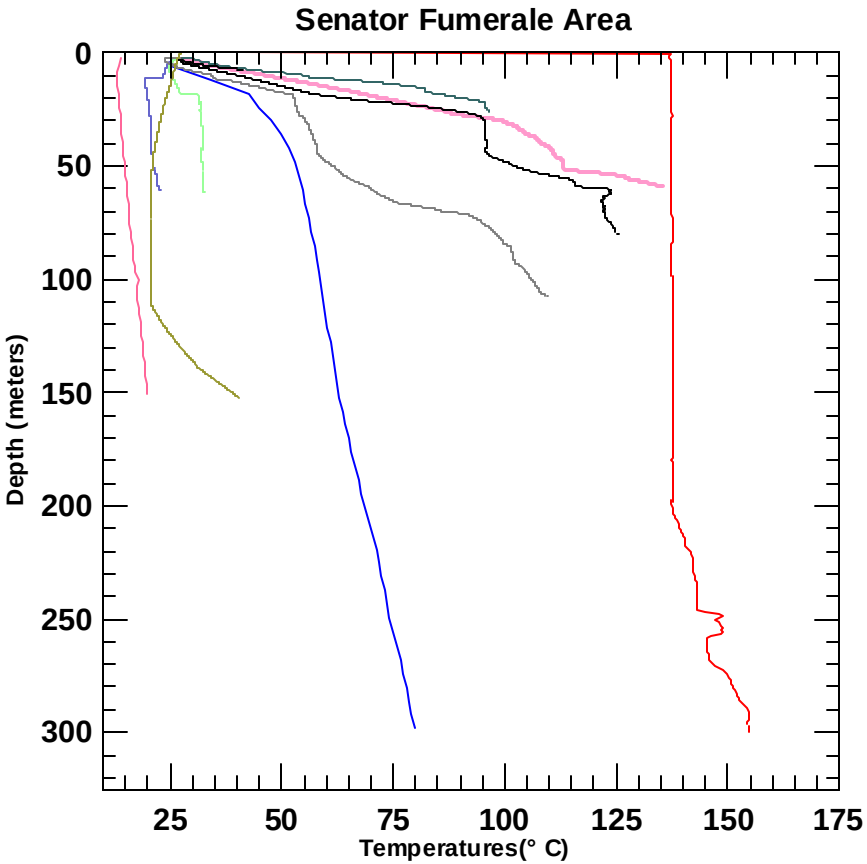
What do they look like in Dixie Valley?




Pirouette Mountain
Depth (meters)
Temperatures(° C)
0
50
100
150
200
250
300
350
400
450
500
550
600
650
10
20
30
40
50
60
70
80
90
3526
3527
3532
3508
3524


Eleven Mile Canyon
Depth (meters)
Temperatures(° C)
0
50
100
150
200
250
300
350
400
450
500
550
600
650
10
20
30
40
50
60
70
80
90
3331
3317
3355
3349
3313
3323


Dixie Meadows
Depth (meters)
0
50
100
150
200
250
300
350
400
450
25
50
75
100
125
150
Temperatures(° C)


Senator Fumerale Area
Depth (meters)
0
50
100
150
200
250
300
25
50
75
100
125
150
175
Temperatures(° C)

BASIN AND RANGE FAULTING CHARACTERISTICS

- **Breakage to Brittle/Ductile Transition**
- **Multiple Steep Faults of Varied Strike (Transfer zones, passive relays, active relays)**
- **Faulting in Valley (Piedmont)**
- **Faulting in Ranges (generally not recognized)**
- **Facies Associated with Active Faulting (fans not where expected)**
- **Landslides and Large Scale Slumps**
- **Antithetic Faulting and Graben Formation**
- **Displacement of Surface Manifestations**


To Be Continued